

Navy Manpower and Personnel Modeling, Simulation and Optimization Tools

Brief to MORs

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Background

- Navy communities include enlisted ratings (e.g., electronics technicians) and officer designators (e.g., surface warfare officers)
- Navy community managers are responsible for the development, both in the short- and long-term of their communities
 - **They need to understand the effects of a wide variety of policies and procedures**
- Navy community managers need a variety of decision support tools to facilitate their work

Issues

- During the past 30 years there have been many decision support tools have been developed for Navy community managers
- They have largely fallen by the way-side for a variety of reasons:
 - They do not address community manager needs
 - Difficult to use
 - Lack of transparency
- ONR is sponsoring research to remedy this situation

Approach & Research Team

- **A wide variety of skills are required to produce an operational decision support system, and ONR has constructed a research team accordingly**
 - **SPAWAR, San Diego – user requirements**
 - **NPRST – domain expertise and access to data**
 - **CNA – domain expertise and modeling**
 - **Icosystem – systems engineering and modeling**

Methods

- We intend to build upon existing knowledge and on-going research
- Current CNA research - developing a simulation model for enlisted personnel on Virginia class submarines
- Current Icosystem research
 - **S**imulation **T**oolset for **E**xperimental **E**nvironment **R**esearch
 - **I**ntegrated **M**anpower and **P**ersonnel **A**gent-Based **C**omputer **T**ool

Simulating MPT&E and measuring FIT

- **FIT measures unit manning**
 - **FIT is the overarching objective of the Navy MPT&E system**
- **ONR sponsored CNA research, aimed at improving FIT**
- **Build a model that simulates the MPT&E process**
 - **Simulate the flow of personnel through the MPT&E production line**
 - **Follows industry approach of simulating production lines to understand complex dynamics, bottle necks, inefficiencies, etc.**
 - **Analyze impacts of MPT&E initiatives on FIT**
- **Focus on Virginia class submarines**

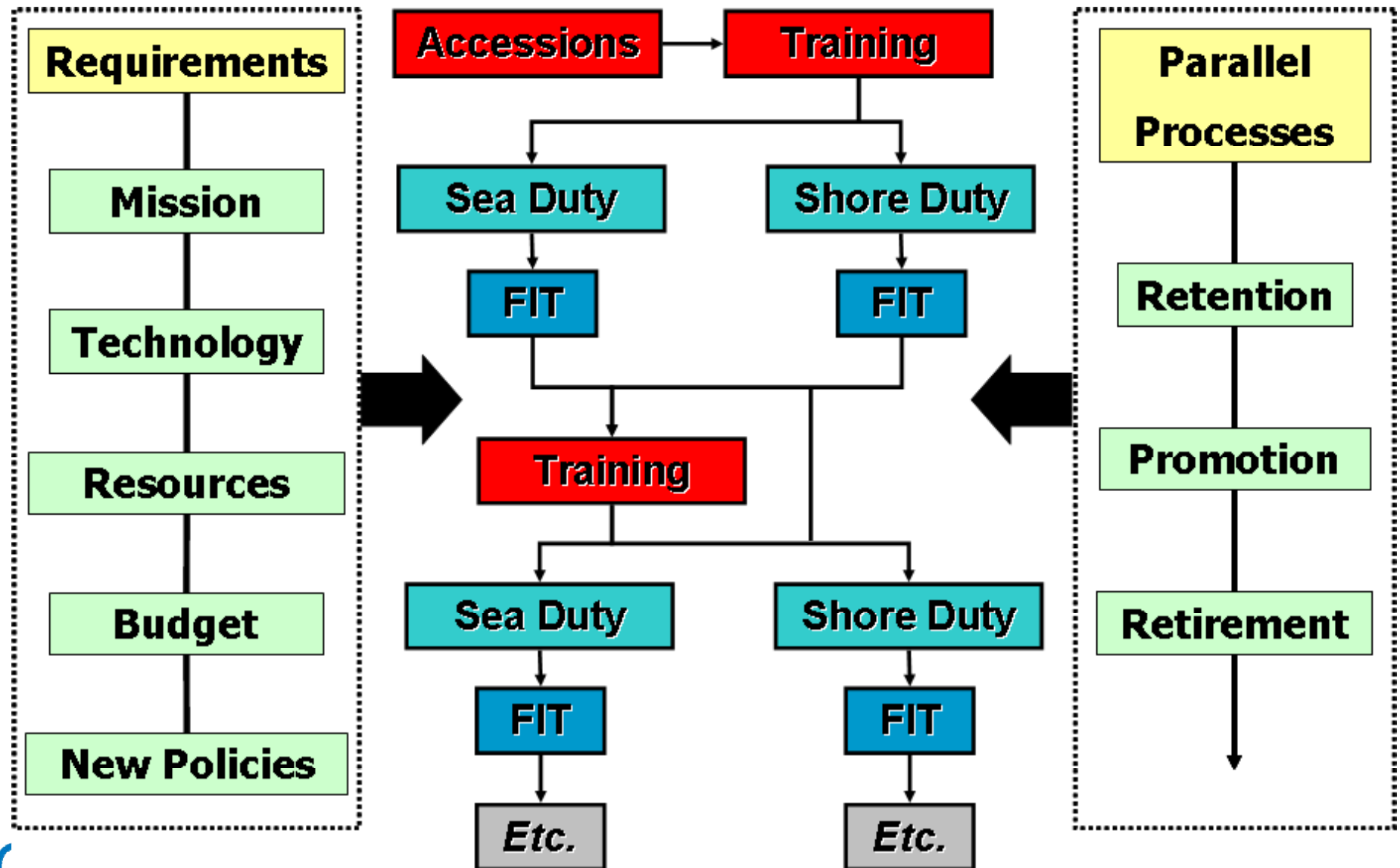
Simulation model overview

- A top down approach
 - Start with flows at a macro level and develop more detail over time
- Address the numerous processes that apply to personnel and guide their movements in the Navy
 - Recruiting, Training, Distribution, Retention, Advancement
- The model will be able to explore policy changes and their impact on metrics such as:
 - FIT, MPT&E budgets (recruiting, training, retention, PCS costs), NEC utilization, School capacity, etc.

Modeling approach

- **Simulation model**
 - User friendly front-end and displays
- **Use of individual-level data**
 - Capability to accurately reflect impact of changes at a micro-level
- **Hybrid model**
 - Historical aggregate rates for selected actions
 - Behavioral models to generate impact of changes in policies and resources at the micro-level
- **Using ExtendSim**
 - Mature off-the-shelf simulation software
 - Excellent development environment
 - Radically reduces model programming time
 - NMCI compliant

Street → Fleet → Career → Retirement



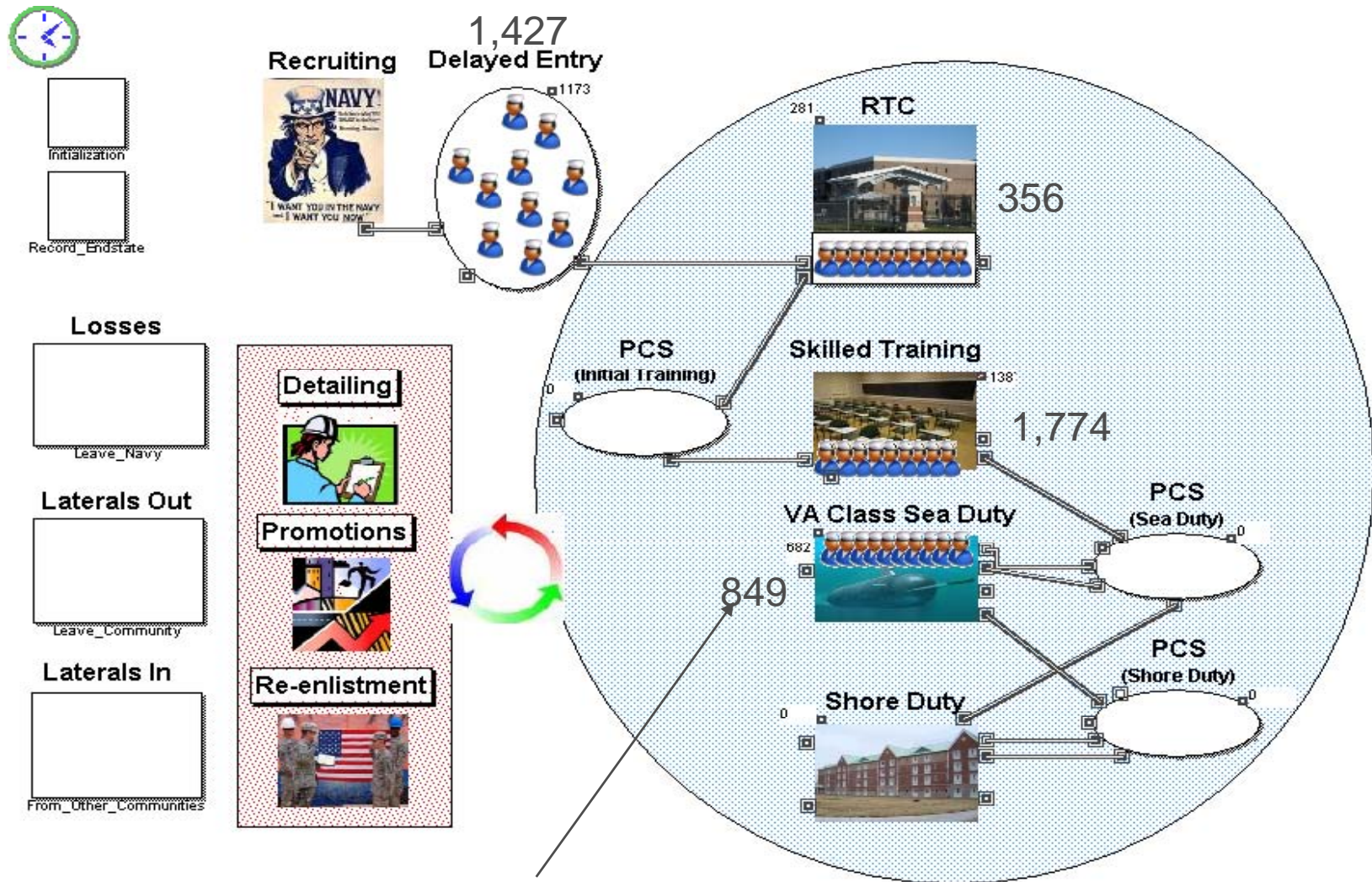
Progress to date

- **Prototype model developed**
- **Macro flows established**
 - **Recruiting**
 - **Training**
 - **Sea/shore rotation**
 - **Retention**
 - **Advancement**
- **Model tested for Virginia class submarines**
- **Many details remain to be added**
 - **Details below**

Further potential model development

- **Add more detail to existing model flows**
 - **E.g., add geographic location to UICs**
- **Incorporate cost data**
- **Use of retention rates**
- **Incorporate econometric and behavioral effects**
- **Move beyond Virginia class**

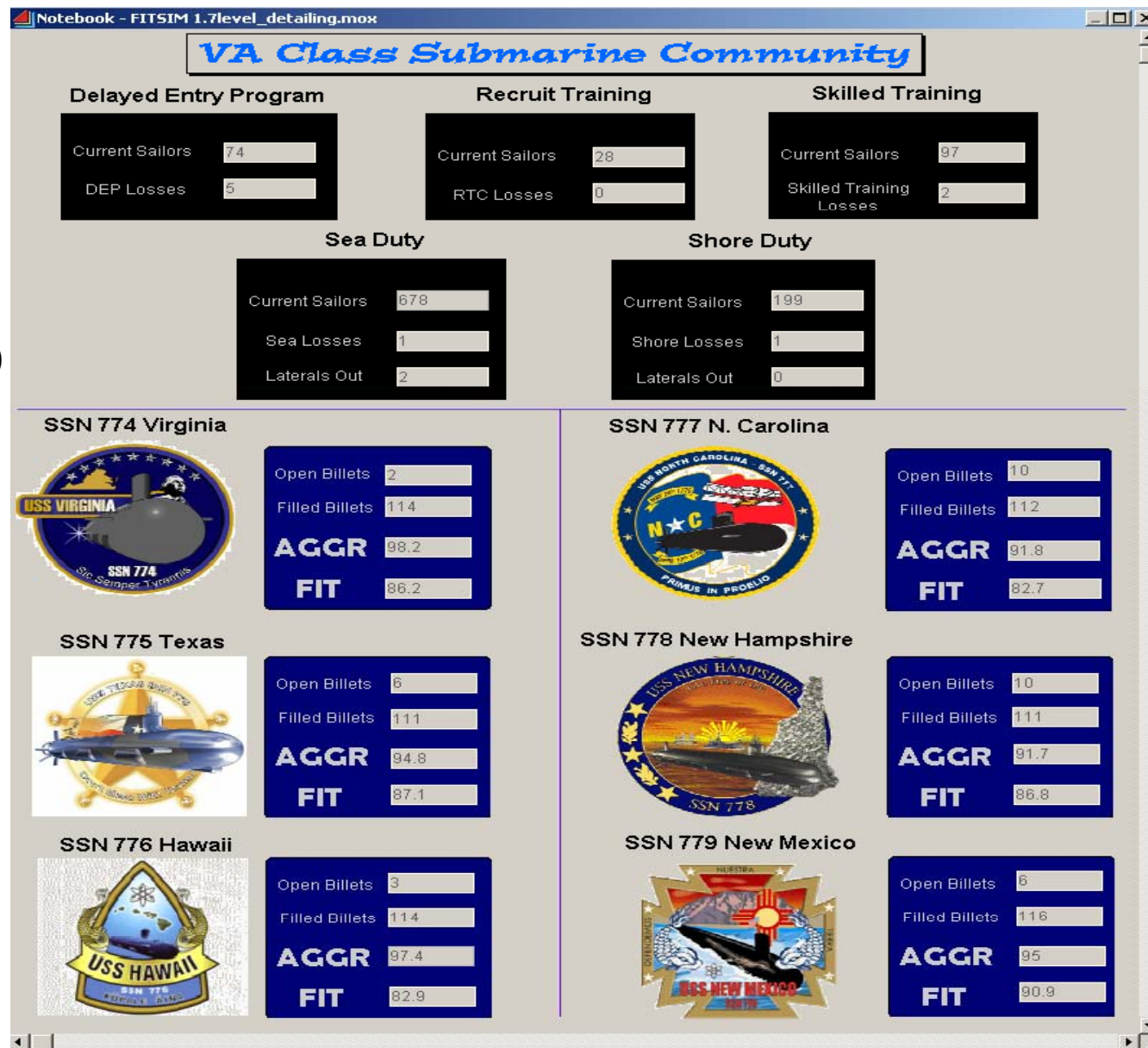
Sample model screen shot



Virginia: 118, Texas: 112, Hawaii: 107, North Carolina: 119,
 New Hampshire: 112, New Mexico: 116, Missouri: 112, California: 53

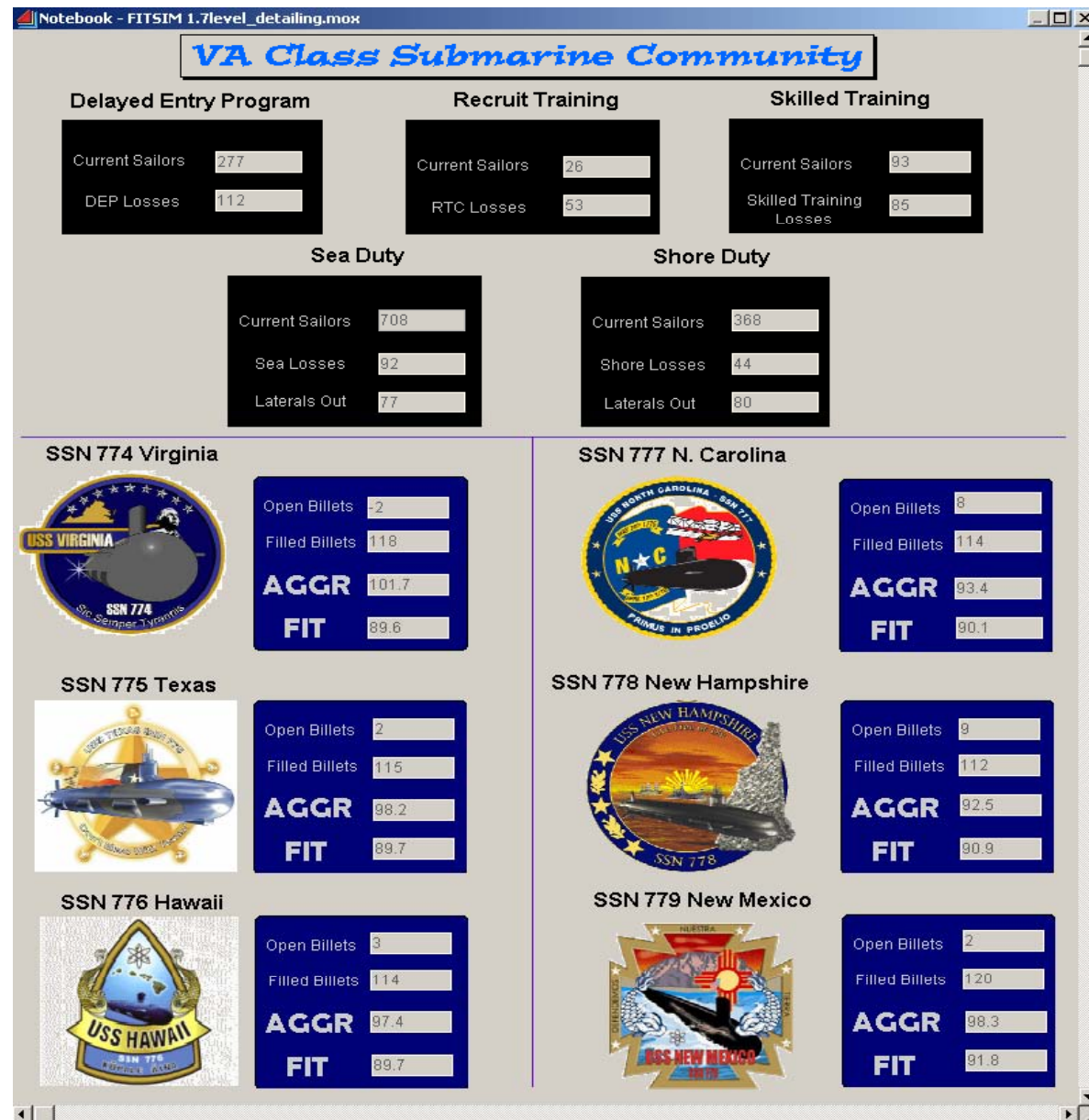
Simulation Model Output Summary

Starting
Inventory:
End of FY09



Simulation Model Output Summary

**Projected
Inventory:
End of FY13**




Baseline

- Starts with end of FY09 inventory
- 240 Recruits into the DEP for VA class subs
- Skill training classes convene once a month
- Sea and Shore tours are 4 and 3 years respectively

	VA SSN 774	TX SSN 775	HI SSN 776	NC SSN 777	NH SSN 778	NM SSN 779
Aggregate % End FY09	100	95.7	100	96.7	93.4	95.1
FIT % End FY09	87.1	87.2	84.6	83.6	86.9	91.0
Aggregate % End FY13	101.7	98.3	97.4	93.4	92.6	98.4
FIT % End FY13	89.7	88.9	89.7	90.2	91.0	91.8

Changing Accessions to 160 into VA class subs


Baseline
 160
Accessions

	VA SSN 774	TX SSN 775	HI SSN 776	NC SSN 777	NH SSN 778	NM SSN 779
FY09 Aggregate %	100	95.7	100	96.7	93.4	95.1
FY09 FIT %	87.1	87.2	84.6	83.6	86.9	91.0
FY12 Aggregate %	102.6	91.5	82.9	88.5	90.1	82.0
FY12 FIT %	84.5	79.5	79.5	82.8	82.8	80.3
FY12 Aggregate %	94.0	97.4	79.5	88.5	95.9	81.2
FY12 FIT %	80.2	76.1	76.1	82.0	81.2	77.9

	DEP	RTC	Skill Training
End FY09 Inv.	79	45	113
End FY12 Inv.	222	21	93
End FY12 Inv.	2	21	93

STEER Objectives

- Create a flexible simulation platform to test and demonstrate capabilities for various MPT&E models
- Help to analyze and quantify the impact of varying policies on individual, unit, and enterprise behavior
- Facilitate the generation and testing of ideas, concepts
- Automated model testing and verification
- Automated graphical displays
- Transparency on model logic
- **STEER provides an environment for model operations**

STEER: Multiple User Types

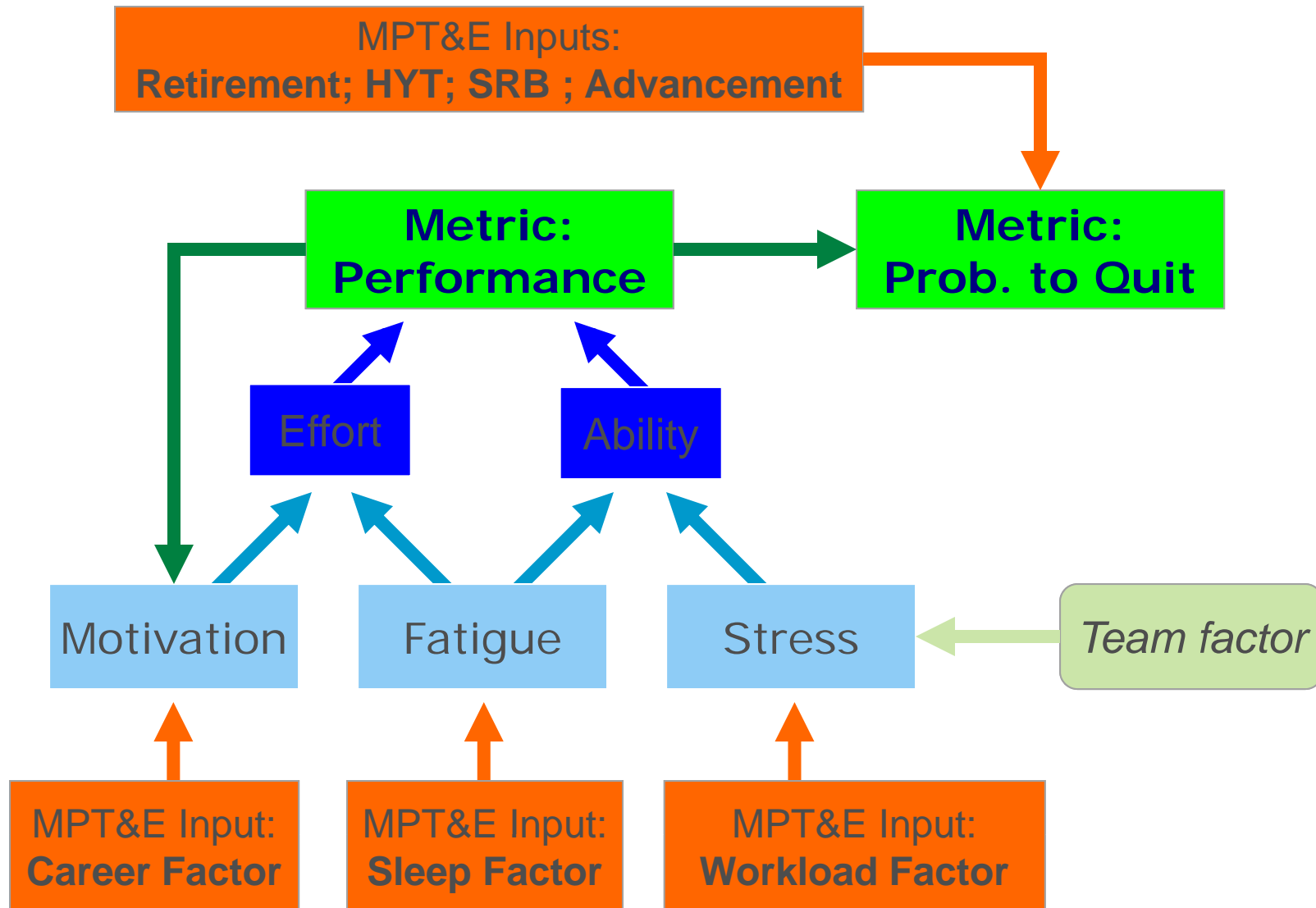
3 Core User Types/Interaction Modes

- **Analysts / End Users**
 - **Experiment with Models**
 - **Domain Expertise, Questions/Tool Expertise**
- **Modelers**
 - **Analyst + Develops Models**
 - **Domain Expertise, Modeling Expertise**
- **Developers**
 - **Expand Core Functionality**
 - **Software/Architecture/Modeling Expertise**

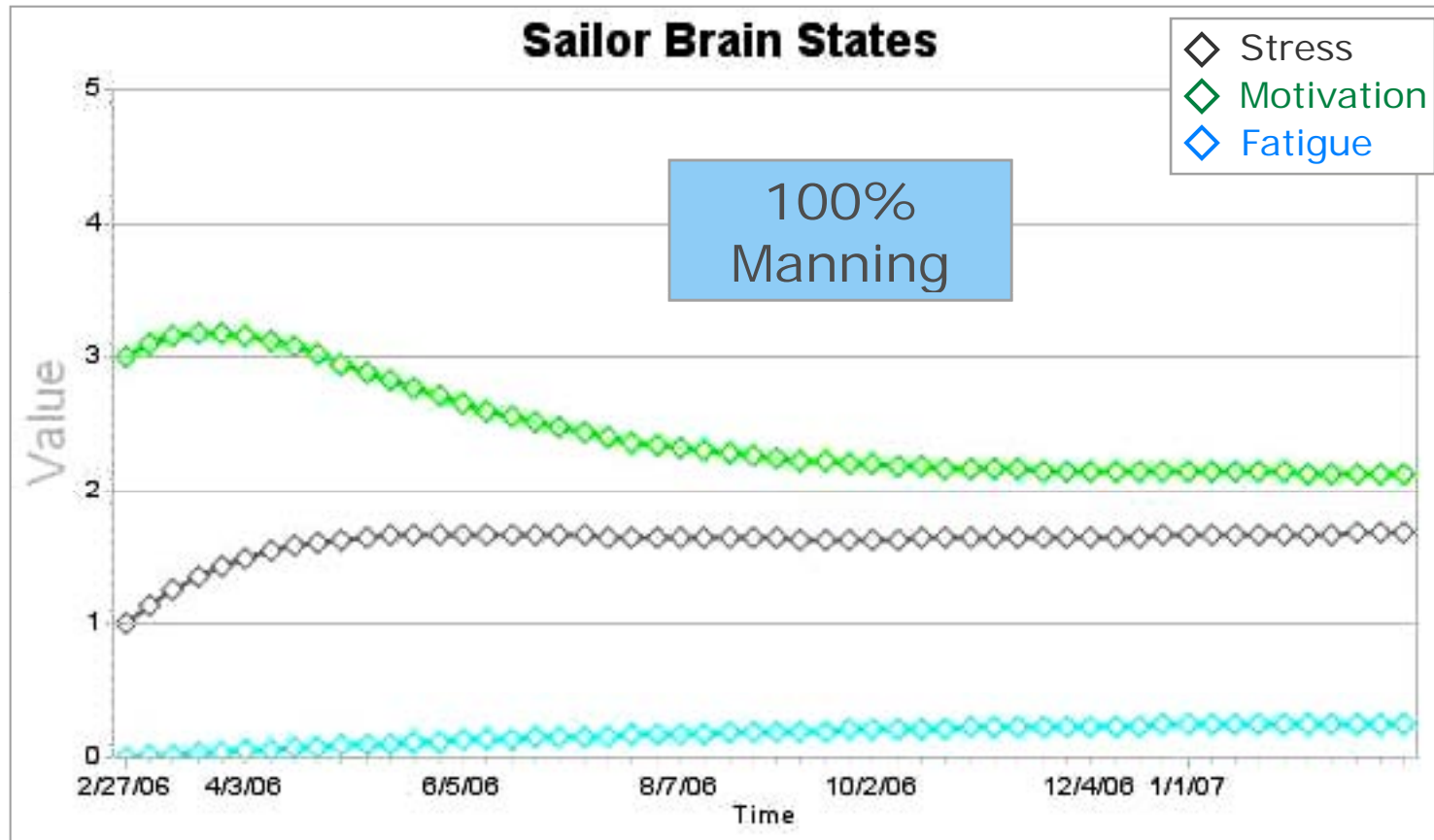
IMPACT capabilities

- **Simulate Navy operations over multiple years**
- **Include high level of detail of most MPT&E systems and processes**
- **Manage multiple skill levels and pay scales**
- **Balance training and working periods**
- **Include personnel stress and fatigue resulting from understaffed ships**
- **Include optimizer to find best staffing levels under various constraints**

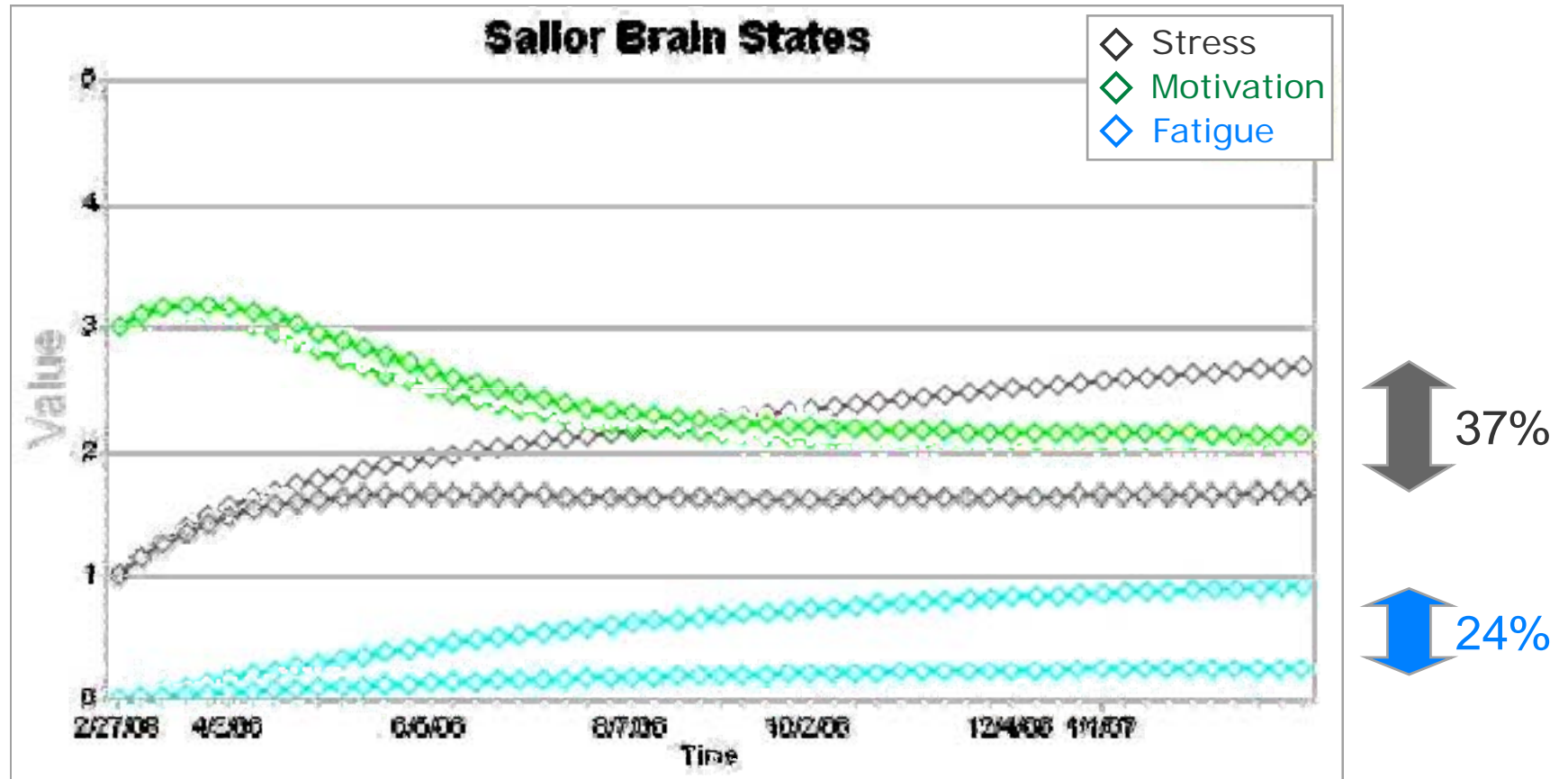
The Dynamic Sailor Model



Sample Scenarios: Nominal



Optimize Cost Only



Cost-only optimization leads to dramatically reduced performance